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Ising model with competing axial interactions in the static fluctuation approximation

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Abstract

An original method, namely, the static fluctuation approximation (SFA) was used to study the thermodynamics of an Ising model with competing interactions between the nearest and next-nearest layers in the presence of an applied magnetic field. Three magnetically ordered phases (ferromagnetic, metamagnetic, and modulated) meeting at a multicritical point (the Lifshitz point) are shown to exist. Asymptotic expressions near the Lifshitz point for transition lines and the line of tricritical points are obtained. The modulated structure near the critical surface is shown to be a distorted sinusoidal wave with a period determined by the ratio γ of the competing interactions; in a zero magnetic field, only odd higher harmonics are present, whereas in a nonzero applied magnetic field, both even and odd harmonics exist. The nth-order harmonic asymptotically depends on the nth power of the fundamental harmonic. Expressions for correlation functions that correctly describe the modulated phase and exhibit characteristic oscillations are obtained.